

Softwood Dieback and Jack Pine Budworm Defoliation in Wisconsin

An Analysis of Survey and Forest Inventory and Analysis (FIA) plot data

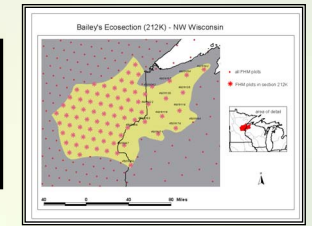
S. Dahir and J. Cummings Carlson
WI Department of Natural Resources,
3911 Fish Hatchery Rd
Madison, WI 53711
Sally.dahir@dnr.state.wi.us, 608-275-3319
Jane.cummings-carlson@dnr.state.wi.us, 608-275-3273



Larva of the jack pine budworm

Introduction

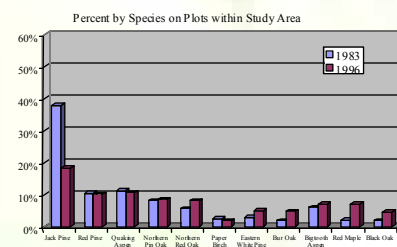
Average dieback of softwood tree crowns in 1999 was rated between 10 and 18% on FHM plots in northwest Wisconsin - Southern Superior Ecoregion. An analysis of survey and FIA plot data was conducted to determine the cause.



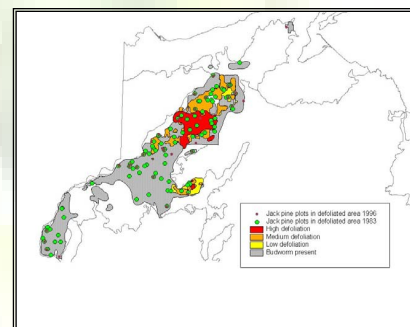
Location of FHM plots in the Southern Superior Ecoregion.

Methods

STEP 1. FIA data from all plots within the study area were used to determine which species of softwood were most prevalent. **Jack pine** was the most common softwood throughout the area for both the 1983 and 1996 FIA surveys.



STEP 2. The most recent outbreak of jack pine budworm, *Choristoneura pinus pinus* Freeman, occurred from 1992 to 1998. Each year during the outbreak, aerial and ground surveys were conducted to delineate the outbreak areas and record the level of defoliation as high (>50% of the susceptible foliage affected); medium (25-49% of the susceptible crown affected) and low/present (budworm present and 0-24% of the susceptible crown affected). Digitized polygons of defoliation were created for each of the 6 years and distinguished as to the level of severity. A spacial overlay of FIA plots from the 1983 and 1996 data bases was conducted to determine which plots were located in areas with each of the 3 levels of defoliation. Where plots occurred in overlapping areas, they were assigned to the highest level of defoliation. Analysis was limited to plots which were measured in both cycles and which either were jack pine forest type or had a substantial component of jack pine in 1983.



FIA plots located within areas defoliated by the jack pine budworm, 1992 - 1998.

STEP 3. Site factors and stand characteristics that are known to place jack pine stands at a high risk for defoliation and subsequent dieback were chosen for analysis. These included:

- Site quality (determined by site index and habitat type)
- Stocking
- Stand age
- Basal Area
- Species diversity
- No. of open-grown dominants



Open-grown dominant trees are very susceptible to heavy defoliation.

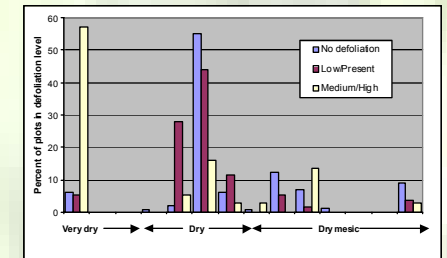


Dieback of jack pine defoliated by the jack pine budworm.

STEP 4. Analysis of variance (Systat) was used to determine the significance of differences between variables within each inventory and a two-sample t-test to compare variables between inventories.

Results

The single most important variable distinguishing plots with medium to high levels of defoliation from low levels or no defoliation was **site quality**, reflected in both habitat type and site index. In both inventories, site index was over 12% higher in non-defoliated areas and productivity was 10% lower compared to plots in highly defoliated sections. Plots in the medium to high levels of defoliation also had significantly **lower basal area** per acre of all species, significantly **higher percent of non-stocked** area and significantly **high percentages of open-grown trees**. All



Percent of plots located in areas within each level of defoliation which fall along a moisture gradient for habitat type. Defoliation is most severe on very dry sites.

of these factors suggest that an open stand structure predominates on plots in highly defoliated areas.

Conclusion

Two factors support the hypothesis that the softwood dieback was caused by defoliation by the jack pine budworm. These include the **predominance of jack pine** on these plots and the prevalence of **site factors** known to put jack pine at high risk for defoliation and subsequent dieback.

Discussion

This analysis also illustrates how FIA data may be used to determine areas which might, in future, be particularly susceptible to outbreaks. For instance, it is well known that an increase in tree stress and the **production of staminate flowers**, the main food source for emerging larvae, put trees at much higher risk of defoliation by budworm. The association of higher levels of defoliation with stands which are open-grown or poorly-stocked, have a high component of jack pine or are located on droughty, poor sites all support this conclusion. Not only do these factors serve to augment staminate cone production but also increase the ability of budworm larvae to find an uninterrupted and plentiful supply of food.



A high production of staminate cones is a known risk factor for defoliation by the jack pine budworm.

However, these highly defoliated stands are constantly changing, either as a result of defoliation or because other lower risk species are being planted to replace them. This fact suggests that future analyses may help predict if and where the risk of budworm defoliation will be highest. With a more continual FIA inventory these types of analyses should not only be more accurate but help predict where preventive management might best be applied.